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Butternut—Strategies For Managing A Threatened Tree

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Butternut—Strategies For Managing A Threatened Tree

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Butternut (*Juglans cinerea*) is being killed throughout its range in North America (fig. 1) by *Sirococcus clavigignenti-juglandacearum*, a fungus of unknown origin causing multiple branch and stem cankers that eventually girdle infected trees (USDA Forest Service 1993). Sprouts, if they develop, are also infected and killed usually within the first few years. The disease was first reported from Wisconsin in 1967 (Renlund 1971), but it probably was present in the State for several years before then (Kuntz *et al.* 1979). The fungus was described as a new species in 1979 (Nair *et al.* 1979) and only butternut is known as its natural host, although black walnut and many other *Juglans* species and hybrids can be infected when wound-inoculated (Orchard *et al.* 1982).

Butternut is valued for its wood for furniture, paneling, specialty products, and carving, and for its nuts. Ecologically, butternut is an important source of wildlife mast, especially in the northern portion of its range where walnut is not present. Butternut is not commonly found growing in great numbers anywhere in its range, so there is concern to maintain a viable butternut population to preserve biodiversity in the eastern forests.

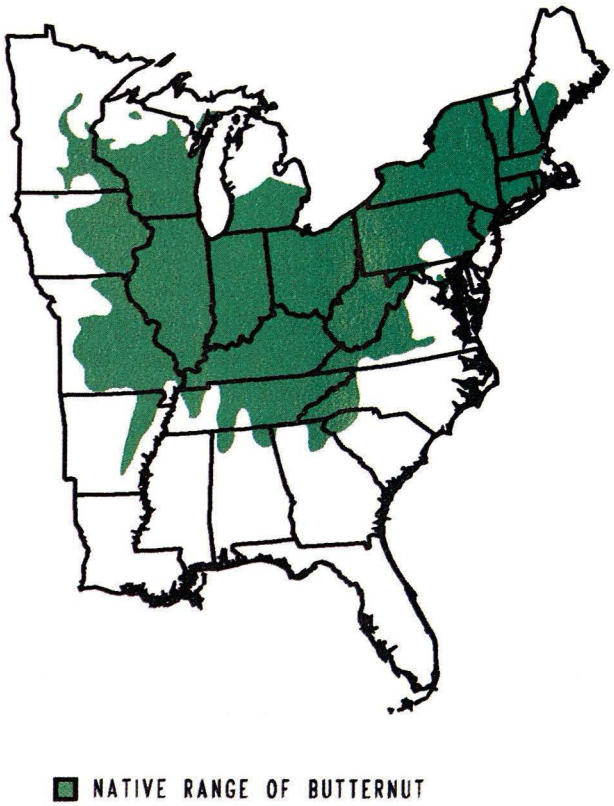

Figure 1.—*Native range of butternut.*

GROWING REQUIREMENTS OF BUTTERNUT

Butternut is a small- to medium-size tree, 40-60 feet high and 12-24 inches in diameter (maximum size 110 feet and 60 inches), seldom exceeding 75 years of age. It commonly grows on rich loamy soils as well as on drier, rocky soils of limestone origin. On deeper soils it forms a taproot and wide-spreading lateral roots. Butternut never occurs in pure stands, although it is occasionally abundant locally in mixed hardwood forests (Rink 1990, Harlow *et al.* 1978).

Butternut is a shade intolerant species. Young trees may withstand competition from the side, but will not survive shade from above. Butternut must be in the overstory to thrive (Rink 1990, Harlow *et al.* 1978). Reproduction can only be sustained in stand openings or fields where shade cannot impede its development. The minimum size area needed to establish and promote early development of intolerant species is about 2 to 3 times the height of the surrounding dominant trees. Generally,

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openings smaller than 2 acres have a large proportion of their area on the edge where reproduction grows slowly because of shading from the surrounding trees (Clark and Hutchinson 1988). As intolerant trees begin to develop, room must be provided for them to grow into and stay in the upper canopy. Thus, over time, smaller openings must be enlarged, or thinnings made, to allow for full growth and development of the trees.

Seed production begins at about 20 years, and is optimum between 30-60 years of age. Good seed crops occur every 2-3 years, although some seed is produced every year. Squirrels and other rodents are aggressive consumers of butternut seed, and premature seed losses due to insects and lack of pollination often cause low viable seed yields. Seeds usually germinate in the spring following seedfall. Stumps of small diameter butternut trees and saplings are capable of sprouting (Rink 1990).

DISEASE DISTRIBUTION AND IMPACT

A recent compilation of USDA Forest Service Forest Inventory and Analysis forest inventory data show a dramatic decrease in the number of live butternut trees throughout the United States in the last 10 to 15 years. For example, live butternut, in all size classes combined, decreased by 58 percent in Wisconsin and 84 percent in Michigan during this period. These data do not distinguish healthy from diseased trees. A recent Wisconsin Department of Natural Resources survey revealed that 91 percent of the live butternut in all age classes in Wisconsin were diseased (Cummings Carlson 1993). Forest inventory surveys in North Carolina and Virginia showed a 77 percent decrease in butternut from 1966 to 1986 (Robert Anderson, personal communication). An inventory in the Great Smoky Mountains National Park showed that all 77 butternut trees remaining there were diseased (Keith Langdon, personal communication). In addition, many older butternut trees throughout the species' range are declining from causes other than the canker disease.

The Minnesota Department of Natural Resources placed a moratorium on the harvest of healthy butternut from State land administered by the Division of Forestry in August 1992. The USDA Forest Service in March 1993 also placed harvest restrictions on healthy butternut on National Forests. Butternut is currently listed under Category 2 on the list of Endangered and Threatened Plants under the Endangered Species Act. This category includes species for which there is some evidence of vulnerability, but not enough data to support listing at this time. Additional data on the health of butternut are being collected in several States to determine if it is a Threatened species.

DISEASE DESCRIPTION

Young cankers are elongated, sunken areas that commonly originate at leaf scars and buds, often with an inky black center and whitish margin (Nicholls *et al.* 1978). Peeling the bark away reveals the brown to black elliptical areas of killed cambium. Older branch and stem cankers are perennial, found in bark fissures or covered by shredded bark, and bordered by successive callus layers. Cankers commonly occur at the base of trees and on exposed roots. Branch cankers usually occur first in the lower crown, and then stem cankers develop from spores washing down from branch cankers (Tisserat and Kuntz 1983a). The fungus can survive and sporulate on dead trees for at least 20 months (Tisserat and Kuntz 1984).

FUNGUS DESCRIPTION

Spores (conidia) of the fungus are disseminated from fruit-bodies (pycnidia) by rainsplash and possibly by insects. Spores are produced throughout the growing season (Nicholls 1979, Tisserat and Kuntz 1982). Once airborne, they can survive and be dispersed long distances during favorable weather conditions of cool temperatures and overcast skies (Tisserat and Kuntz 1983b).

MANAGEMENT GUIDELINES

Coalescing cankers eventually kill severely affected trees. Such trees can be harvested early to salvage the quality and value of the wood, or the tree can be maintained in the stand for its wildlife value. Care needs to be exercised in evaluating trees for butternut canker so that trees with dead branches are not automatically considered diseased. Another fungus, *Melanconis oblongum* (perfect state *M. juglandis*), often colonizes dead butternut tissues but does not cause lethal cankers.

One of the major objectives of the following tree retention guidelines is to create stand conditions that will result in the establishment of natural regeneration. Trees free of canker, or those able to overcome infections, should be retained to reproduce. Natural regeneration will probably not survive in stands that have susceptible trees and a high incidence of the disease. Resistant seedlings, when available, should be planted in these stands and elsewhere.

Because butternut is an intolerant species, successful regeneration will require that competition be controlled within the small openings created by single-tree or group selection or in larger clearcuts. In some areas, seed or seedlings may have to be planted and protected from squirrels. Vigorously growing saplings may escape the girdling effects of cankers.

TREE RETENTION GUIDELINES
THE 70-20-50 RULE

- Retain all trees with more than 70 percent live crown (figs. 2 and 3), and less than 20 percent of the combined circumference of the bole and root flares affected by cankers (fig. 4).

- Retain all trees with at least 50 percent live crown (figs. 3 and 5), and no cankers on the bole or root flares.

- Dead butternut, and butternut of poor vigor, may be cut.

Crown dieback is defined as branch mortality that begins at the terminal portion of a branch and progresses toward the trunk. Consider only those branches in the outer and upper part of the crown when rating dieback. Interior and lower crown branches are considered as having died from shading and are not considered dieback. Do not include old dead branches (those without twigs less than 1 inch at the point of attachment) in the dieback estimate.

Figure 2.—*Healthy crown.*

Figure 3.—*Fifty percent live crown (left) 70 percent live crown (right).*

Figure 4.—*Cankers affecting 20 percent of the bole circumference.*

Figure 5.—*Less than 50 percent live crown.*

Figure 6.—*Small volume but greater than 70 percent live crown.*

Sometimes large parts of a crown are missing, which may result in a percent live crown rating of 70 or greater, but a very small crown volume (fig. 6 on previous page). If butternut canker is responsible for the loss of crown volume, there is almost always evidence of bole canker. If some other factor such as storm breakage destroyed the crown, decide if the tree is likely to survive until the next stand entry. We recommend erring on the side of retention, providing site conditions are created to promote natural regeneration.

These guidelines will enable marking crews to objectively select those trees that have a reasonable chance of surviving for 15 years. Some trees that have a 50 percent live crown may not survive the 15 years between stand entries even in the absence of canker. However, this risk should be taken in the interest of increasing seed production and retaining possible canker-resistant germplasm.

STRATEGIES TO MAINTAIN HEALTHY BUTTERNUT

Some of these suggested strategies are already underway in some areas within the range of butternut and should be expanded to other regions. Managers and organizations interested in restoring butternut should continue these strategies and consider adopting the others.

- Conduct a range-wide inventory of butternut to assess its general health, and the incidence and severity of butternut canker.
- Increase understanding of butternut canker disease cycle.
- Develop effective silvicultural methods to assure adequate regeneration.
- Begin a seed collection program and test seeding and outplanting strategies to augment natural regeneration.
- Locate resistant trees in the forest.
- Establish clone banks and seed orchards using various propagation techniques, including tissue culture, to preserve germplasm potentially resistant to the disease.
- Test the potential to develop resistant butternut using classical intraspecific tree breeding techniques.
- Monitor the effects of conservation strategies on butternut in the forest and make any needed adjustments.

GUIDELINES FOR SELECTING POTENTIALLY RESISTANT TREES

Occasionally healthy butternut trees are found near diseased and dying trees. Although these healthy trees may have escaped the fungus, it is more likely they may have resistance to the disease. Trees that are disease-free, or are apparently able to reduce or inhibit canker expansion, may have value in future tree improvement efforts and should be retained in the stand.

- A candidate tree for study of canker resistance must be in a stand that exhibits a high incidence of the disease and should be within 100 feet of a diseased tree so that it has had a reasonable chance of exposure to the pathogen.
- The candidate tree should be at least 10 inches d.b.h. and must be free of cankers, or if cankers are present, the tree must have overgrown them.
- The manager/landowner must be willing to allow collection of scion wood and seed from the tree for several years.

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Briefly describes the disease of butternut caused by *Sirococcus clavigignenti-juglandacearum* and provides suggestions for conserving resistant butternut, including guidelines for natural and artificial regeneration.

KEY WORDS: *Juglans cinerea*, butternut canker, disease resistance.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

NORTH CENTRAL FOREST EXPERIMENT STATION

The Northeastern Area State and Private Forestry is responsible for insuring the productive use of the forest resources in the Northeast and Midwest, on lands of all ownerships. The purpose of the Forest Health Protection (FHP) staff within the Northeastern Area is to protect and report on the health of forests within the Northeastern Area, by working with State and Federal cooperators.

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